Title: Approximation of Pi

Link to Outcomes:

- **Problem Solving** Students will demonstrate the ability to solve problems in mathematics through cooperative and individual settings.
- **Communication** Students will demonstrate the understanding of mathematical concepts using language and symbols.
- **Connections** Students will demonstrate the ability to connect algebraic topics to concepts of computer science.
- **Probability** Students will apply concepts of geometric probabilities to concepts of computer science.

Brief Overview:

Students will approximate *pi* by writing a computer simulation of points being randomly placed in regions defined by a unit circle circumscribed by a square and a square inscribed in the circle. The instructor will need to determine the amount of computer expertise of the students carefully before assigning the final project.

Grade/Level:

Grades 8-9 / Honors Algebra

Duration/Length:

The lesson may be completed within five class periods.

Prerequisite Knowledge:

Students should have knowledge of:

- appropriate programming in BASIC (see enclosed program).
- how to find an equation of a line in slope-intercept form.
- how to find the equation of a circle in standard form.
- concepts related to geometric probabilities.

Objective:

- To use technology to approximate *pi*.

Materials/Resources/Printed Materials:

- Computer
- GWBASIC

Development/Procedures:

- Write the equation of a *circle* with radius 1 and center (0,0).
- Write the equation of the *line* passing through (1,0) and (0,1).
- Write the equation of the *line* passing through (-1,0) and (0,1).
- Write the equation of the *line* passing through (-1,0) and (0,-1).
- Write the equation of the *line* passing through (0,-1) and (1,0)..
- Draw the *square* with vertices (1,1) , (-1,1) , (-1,-1) , (1,-1) ; the *square* with vertices (1,0) , (0,1) , (-1,0) , (-1,-1) ; the unit *circle* with center at (0,0) on the same coordinate axes.
- Discuss and/or develop concepts of the geometric probabilities related to randomly placing points in regions of the plane.

Evaluation:

The teacher should constantly monitor student progress and assist with problems as they arise.

Extension/Follow Up:

Apply appropriate procedures for other circumscribing and inscribing regular polygon.

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BASIC Program for Approximation of *pi*

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 1 REM ..... FILENAME: APPROXPI

 2 CLS : KEY OFF : RANDOMIZE TIMER

 3 INPUT "How many points will be generated within the circumscribing square";N

 4 CLS : POINTS=0 : INCIRCLE=0 : INSSQ=0

 5 LOCATE 1,1 : PRINT "NUMBER OF POINTS GENERATED: "

 6 X=RND : Y=RND : POINTS=POINTS+1 : LOCATE 1,28 : PRINT POINTS

 7 IF X*X+Y*Y<1 THEN INCIRCLE=INCIRCLE+1

 8 IF Y<-X+1 THEN INSSQ=INSSQ+1

 9 IF POINTS=N THEN 10 ELSE 6

10 LOCATE 3,1 : PRINT "NUMBER OF POINTS IN THE CIRCLE: " : LOCATE 3,33
     : PRINT INCIRCLE : LOCATE 5,1 : PRINT "NUMBER OF POINTS IN THE
       INSCRIBED SQUARE: " : LOCATE 5,43 : PRINT INSSQ

11 LOCATE 7,1 : PRINT "APPROXIMATION OF PI USING AN INSCRIBED
     SQUARE: "; 2*INCIRCLE/INSSQ

12 LOCATE 9,1 : PRINT "APPROXIMATION OF PI USING A CIRCUMSCRIBED
     SQUARE: ";4*INCIRCLE/N : END
```